6.9.1.1

MEMORANDUM **CH2MHILL**

Guy Cave Overfill Area Slope Stabilization

TO: Mary Kay Voytilla/USEPA

FROM: Travis Pyle/CH2M HILL
Jim Stefanoff/CH2M HILL
Jay Dehner/CH2M HILL

DATE: December 20, 2000

1.0 Purpose

This memorandum summarizes CH2M HILL's site visits to the Guy Cave overfill area and provides recommended, conceptual-level slope stabilization alternatives with respective order-of-magnitude cost estimates.

2.0 Site Visit Observations

This section lists observations made by the field teams during CH2M HILL's site visits to the Guy Cave area regarding slope stabilization of the overfill area. Figure 1 provides a plan view of the Guy Cave area. Figure 2 is a cross-section of the overfill area through the center of the overfill slope.

2.1 27 September 2000 Field Visit

The purpose of this field visit was to observe the tension crack, identify potential hazards of the fill area slide, and recommend options for stabilizing the area (these alternatives are summarized in Section 3 of this memorandum).

Field Team: Jay Dehner, Jim Stefanoff, and Bill Hudson

Observation Notes:

- A tension crack was observed within the overfill area approximately 50 feet from the edge of the bench.
- Based on the presence and position of the tension crack, it appears that the overfill slope area is marginally stable.
- There is a need to protect people and equipment in the area by restricting access (above and below) to the potential slide area.
- A drainage ditch from the Upper and Lower Guy Cave areas discharges near the top (south side) of the crack area.
- It appears that there is no infrastructure below that would be directly affected if the overfill area slid. It does not appear that the slide would reach the nearby hoist area of the Cherry Raise.

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- There is an existing drainage ditch along the west side of the Guy Cave access road that crosses the road through a swale and discharges off the east sidehill. The position of the discharge point appears to be acceptable, in that it avoids the mine workings below.

2.2 29 November 2000 Field Visit

The purpose of this site visit was to identify a route to access the toe of the existing fill slope for construction equipment, observe potential slide area impacts from controlled, engineered stabilization of the slope, and potential slide area impacts if the slope was to catastrophically fail.

Field Team: Bob Martin and Bill Hudson

Observation Notes:

- The existing Cherry Raise access road could be extended to allow access up to the existing fill toe. The area below the existing toe, in addition to the access road extension, would need to be cleared and grubbed to allow access for the earth moving equipment.
- There is one narrow spot within the existing Cherry Raise access road (adjacent to the Cherry Raise hoist) where the road width necks down to 16 feet and also has a low-hanging power line. It appears that the power line is energized and that there would need to be coordination with Bob Hopper to de-energize the line and suspend it high enough to pass equipment underneath.
- The toe of the existing side hill rests at the portal of the Utz adit. There is also a Homestake Raise holeout located approximately 100 feet downhill of the existing toe. Burial of the raise is not a concern because it is currently caved, although coordination with Bob Hopper may be needed to cover the raise opening.
- Precautions will need to be taken when working in the immediate areas of the Utz portal and the raise holeout.

2.3 Site Visit Conclusions

Based on the two site visits, the following was concluded:

- The tension crack on the Lower Guy Cave bench confirms that the overfill slope is consolidating and creeping.
- The slope will likely stabilize itself by gradual sloughing and creeping (as it is currently) or, less likely, it will catastrophically fail.
- If the overfill slope catastrophically failed, it appears that the mine substation and Cherry Raise likely would not be impacted due to distance and topography. However, there are some near surface workings (Utz Adit and a Homestake Raise holeout) that are currently collapsed that could be buried.
- The existing drainage ditch from the Guy Cave fill area channels water directly into the tension crack. The additional loading of the water and subsequent lubrication/erosion on the failure plane increases the instability of the overfill slope.

- Because the slope is unstable, the access to the top and bottom of the overfill slope should be controlled. This would preclude any placement of equipment and materials on the bench between the crack and the face of the slope for potential West Fork mitigation work.

3.0 Identified Alternatives

This section provides three alternatives to either isolate or stabilize the overfill slope. Figure 3 is a decision tree that presents the recommended approach. The following text describes the three alternatives referred to in the decision tree.

3.1 Alternative 1: Signage, Fencing, and Regrading Ditch

This alternative includes installing signage and fencing above and below the slide area to warn people of the potential hazards, and regrading the existing stormwater drainage ditch around the base of the Lower Guy Cave. The existing ditch channels water from the Upper and Lower Guy Cave areas into the tension crack. The addition of water into the crack could cause additional loading of the downhill slope and reduced strength at the potential slide failure plane, which could facilitate slope instability. This alternative includes constructing a new ditch around the base of the Lower Guy Cave to avoid the crack, and discharging the stormwater into an existing roadside ditch on the west side of the Guy Cave access road. A portion of the waste rock from cutting the new ditch would be used to fill the existing ditch. The remaining portion would be placed on the overfill slope. The locations of the tension crack, access roads, and drainage ditches (existing and proposed) are shown on Figure 1.

3.2 Alternative 2: Slope Stabilization with Dozers

This alternative includes surveying the overfill slope area and Lower Guy Cave bench, with subsequent slope stabilization modeling to discern the stability of the slope for placement of equipment (i.e., dozers) on the outside edge of the crack. The bench would be leveled perpendicular to the crack and worked downward to a final slope of about 2.5H:1V, as shown in Figure 2. However, if the modeling results indicate slope instability for these types of loads, then Alternative 3 should be considered for any further slope stabilization efforts.

All field efforts would need to be closely coordinated between the engineer and construction contractor to strategize and develop the approach.

3.3 Alternative 3: Slope Stabilization with Drag-line

This alternative includes obtaining access to the toe of the existing overfill area hillside by extending the existing Cherry Raise access road by an estimated 180 feet (15 feet wide). The new road alignment, in addition to the flat area (80 feet by 80 feet) below the fill toe, would require clearing and grubbing. An estimated 5,000 cubic yards of material would need to be removed from the top of the hillside and placed at the bottom by a crane operated drag-line (located behind the tension crack) to decrease the existing 1H:1V slope to an estimated 2.5H:1V slope, as shown on Figure 2. A dozer and excavator would be located at the toe and would alternate work with the drag-line above to slope the hillside and compact the toe in lifts.

This option of working the slope from behind the crack with a crane operated drag-line is conservative in that equipment above is not placed at any time on the outside edge of the crack. Therefore, surveying and modeling is not required for implementation of this alternative, but could help refine the approach.

All field efforts would need to be closely coordinated between the engineer and construction contractor to strategize and develop the approach.

4.0 Cost Estimates

This section provides order-of-magnitude costs (accuracy in the range of plus 50 percent to minus 30 percent). The order-of-magnitude cost estimates are in December 2000 dollars and do not include escalation. The cost estimates have been prepared for guidance in project evaluation based on the information available at the time this memorandum was prepared, and should be carefully reviewed prior to making specific financial decisions or establishing final project budgets. The actual costs for implementing these alternatives are expected to vary based on actual labor and material costs, competitive market conditions, final project scope and other variable factors.

4.1 Alternative 1: Signage, Fencing, and Regrading Ditch

The total estimated capital cost for installing signage and fencing, filling the existing ditch, and constructing a new ditch is $7,700. A cost summary is attached that provides further details.

Cost Estimating Assumptions:

- Installing four signs on the Lower Guy Cave bench (uphill side of the tension crack) with warning fencing (orange, plastic meshed fencing) around the approximately 200-foot-wide face.
- Installing three signs below the existing toe of the overfill area and providing warning fencing to warn of potential sliding and falling rock.
- Filling and compacting the existing stormwater ditch (approximately 60 feet long) using a loader and small compactor, and constructing a new trapezoidal channel (4-foot bottom width with 4:1 side slopes and estimated 200 feet long) using a backhoe and dozer to drain into the existing roadside ditch on the west side of the Guy Cave access road.

Operations & Maintenance Considerations:

- Annual inspection and maintenance of signs, fencing, and the new ditch, especially following spring melt.
- May consider quarterly monitoring of the tension crack by rudimentary means such as crack width measurements and/or installing a tension line spanning the crack (i.e., two metal poles anchored by concrete-filled 5-gallon buckets linked by metal cable) to quantitatively measure the progression of the cracking.

- If the tension cracking continues, other means of protection and/or slope protection should be considered.

4.2 Alternative 2: Slope Stabilization with Dozers

The total estimated capital cost for stabilizing the overfill slope with dozers is estimated at $77,000. A cost summary is attached that provides further details.

Cost Estimating Assumptions:

- A site survey of the overfill slope and Lower Guy Cave bench with slope stabilization modeling.
- It is estimated that 5,000 cubic yards of fill would have to be pushed down from the bench of the Lower Guy Cave by dozers to stabilize the overfill slope. An estimated 50 feet (from the crack to the edge of the bench) would be pushed downhill. The dozers would work the entire slope (including toe) to grade and compact.
- No toe access is needed for this alternative. The slope would be worked downhill to gain access to the new slope toe.
- Quantity estimates are based on topographic drawings of the area and field team observations. A field survey was not conducted for this conceptual-level analysis.
- A 30 percent contingency factor is included in the cost estimate to help cover any unforeseen scope changes that have not already been identified.
- Temporary and permanent erosion control would be provided along the new slope and the area immediately downhill from the toe.

Operations & Maintenance Considerations:

- Annual inspection and maintenance of the slope and toe (accessed by hiking into the toe area from the existing Cherry Raise access road) to observe any erosion/or slope failures.

4.3 Alternative 3: Slope Stabilization with Drag-line

The total estimated capital cost for stabilizing the overfill slope with a crane operated drag-line is estimated at $118,000. A cost summary is attached that provides further details.

Cost Estimating Assumptions:

- 180 feet (15 feet wide) of access road would be extended from the existing Cherry Raise access road. The road extension and the area immediately below the toe of the fill slope (estimated 80 feet by 80 feet) would require clearing and grubbing.
- The road would be cut at an average slope of 20 percent with one switchback, and surfaced with 6 inches of gravel.
- It is estimated that 5,000 cubic yards of fill would have to be pushed down from the bench of the Lower Guy Cave by a crane operated drag-line to stabilize the overfill slope. An estimated 50 feet (from the crack to the edge of the bench) would be pushed downhill. An excavator would be located at the toe of the slope to move material into

place while a dozer smoothes the slope and compacts the toe of the slope in lifts. The equipment above and below would alternate work timing to reduce risks of falling rock below.

- Quantity estimates are based on topographic drawings of the area and field team observations. A field survey was not conducted for this conceptual-level analysis.
- An estimated 2,000 cubic yards will need to be moved below to re-work the slope, and an estimated 1,000 cubic yards would be compacted in lifts to stabilize the toe.
- A 30 percent contingency factor is included in the cost estimate to help cover any unforeseen scope changes that have not already been identified.
- Temporary and permanent erosion control would provided in the area around the newly cut access road and immediately downhill from the toe of the new slope.

Operations & Maintenance Considerations:

- Annual inspection and maintenance of the slope and toe to observe any erosion or slope failures.

5.0 Recommendations

Table 1 provides a summary of the identified alternatives and their respective costs. Alternative 1 is the least expensive alternative. It provides signing and fencing to warn and keep people away from the slope, and repositions the drainage ditch to prevent stormwater from entering the tension crack. Alternatives 2 and 3 both take actions to physically stabilize the slope. These alternatives would remove the risk, and therefore, the need for warning signs and fencing. Our recommendation is to implement Alternative 1 as soon as possible. If slope stabilization is desired, then Alternative 2 is recommended. Alternative 3 should be considered if the slope stabilization analysis of Alternative 2 determines that the slope is unstable and unsuitable for working with dozers.

TABLE 1
Action Alternative Summary

Alternative Description	Estimated Order-of-Magnitude Cost
Alternative 1: Signage, Fencing, and Regrading Ditch	$7,700
Alternative 2: Slope Stabilization with Dozers	$77,000
Alternative 3: Slope Stabilization with Drag-line	$118,000

If construction efforts are carried forward for the West Fork mitigations work, slope stabilization of the overfill slope by the construction contractor should be considered so that it is the contractor's responsibility for stabilizing their own staging area.

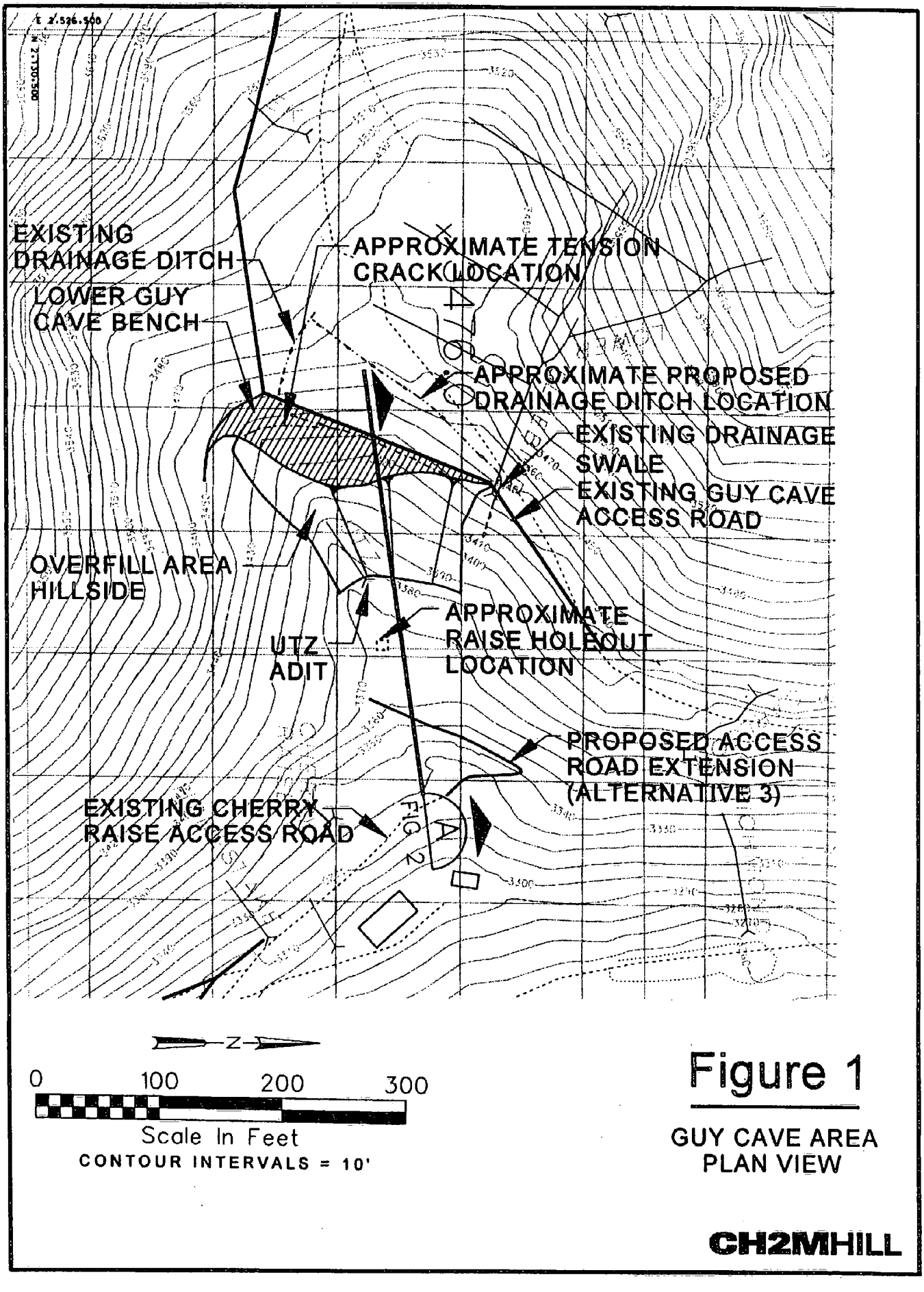

Figure 1

GUY CAVE AREA
PLAN VIEW

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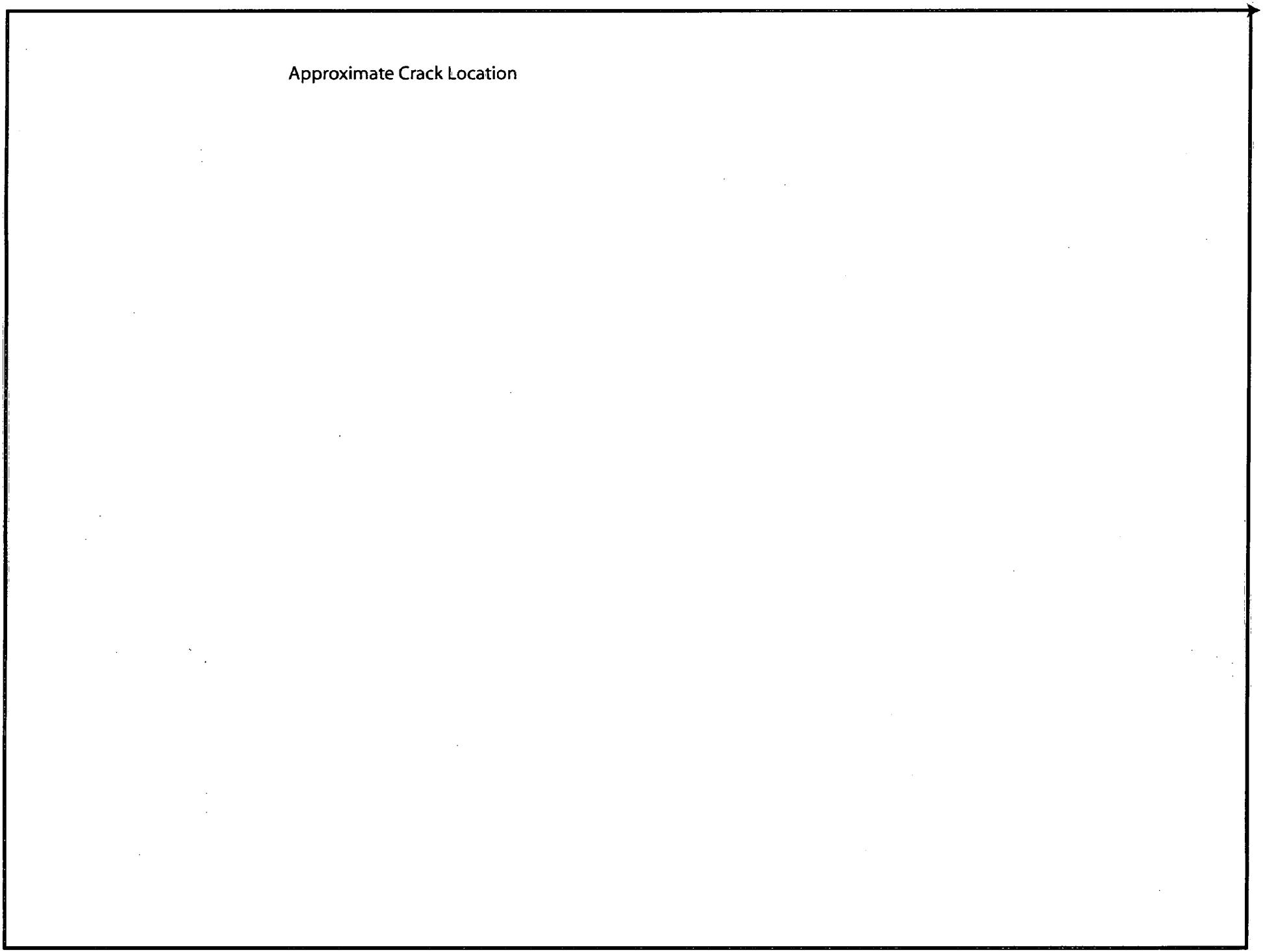
Approximate Crack Location

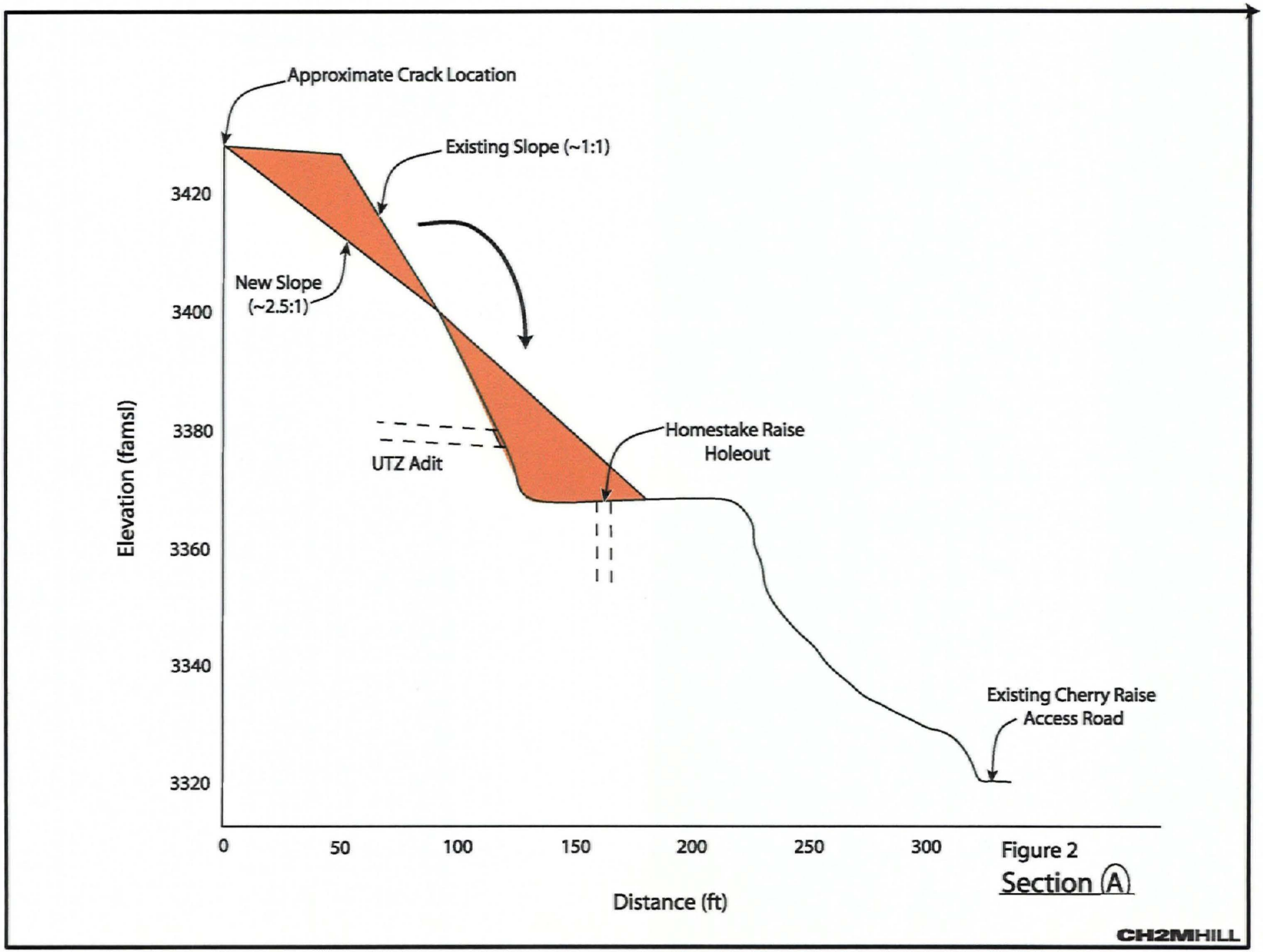

Figure 2
Section (A)

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Figure 2-Fill Slope Section.ai

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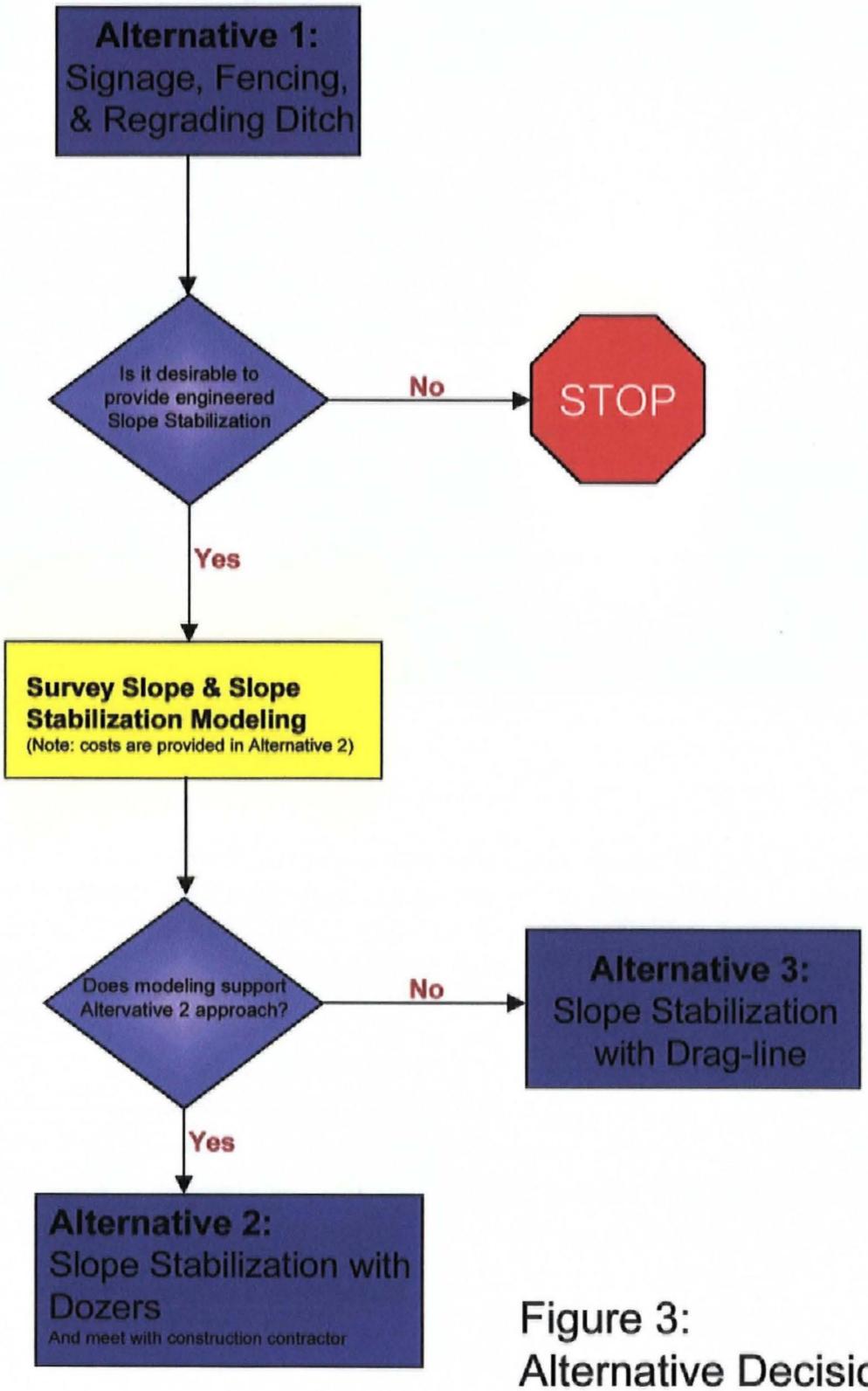

Figure 3:
Alternative Decision Tree

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Alt 1

Bunker Hill **DATE: 12/15/2000**
Guy Cave Slope Stabilization **PROJECT NO.: 152220.ET.02**
Alternative 1 - Signage, Fencing & Regrading Ditch **ESTIMATE BY: D. Hedglin**
Order of Magnitude Cost Opinion

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
Permanent Signage				
Warning Fence @ Top & Bottom of Slope	1	LS	450.00	$450
Signs Top & Bottom of Slope	1	LS	1,446.76	$1,447
Fill Existing Ditch				
Place Material from New Ditch	54	CY	6.36	$344
Construct New Ditch				
Excavate & Move Soil, Shape Ditch	178	CY	10.45	$1,860
SUBTOTAL				**$4,100**
MISC ALLOWANCE	**10%**			**$410**
SUBTOTAL				**$4,510**
CONTINGENCY	**15%**			**$676**
SUBTOTAL				**$5,186**
MOBILIZATION	**15%**			**$778**
CONSTRUCTION TOTAL				**$5,964**
SALES TAX ON MATERIALS	**5.0%**			**$29**
ENGINEERING AND SUPPORT	**20%**			**$1,193**
CONSTRUCTION MANAGEMENT	**8%**			**$477**
CAPITAL TOTAL (ROUNDED)				**$7,700**

NOTES:

Misc Allowance markup is to include items known to exist but cannot be quantified at this time.
Contingency is for scope changes that are presently unforeseen.
Mobilization includes bonds, insurance, temporary facilities, health & safety, demobilization, etc.

NOTE: The above cost opinion is in December 2000 dollars and does not include escalation. The order of magnitude cost opinion shown has been prepared for guidance in project evaluation from the information available at the time of preparation. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final project schedule and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions

Bunker Hill **DATE: 12/19/2000**
Guy Cave Slope Stabilization **PROJECT NO.: 152220.ET.02**
Alternative 2- Slope Stabilization with Dozers **ESTIMATE BY: D. Hedglin**
Order of Magnitude Cost Opinion

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
Move Slope Material				
Survey & Slope Modeling	1	LS	5,000	$5,000
Push from Top & Compact	5,000	CY	7.30	$36,489
SUBTOTAL				**$41,489**
MISC ALLOWANCE	**5%**			**$2,074**
SUBTOTAL				**$43,564**
CONTINGENCY	**30%**			**$13,069**
SUBTOTAL				**$56,633**
MOBILIZATION	**15%**			**$8,495**
CONSTRUCTION TOTAL				**$65,128**
SALES TAX ON MATERIALS	**5.0%**			**$250**
ENGINEERING AND SUPPORT	**10%**			**$6,513**
CONSTRUCTION MANAGEMENT	**8%**			**$5,210**
CAPITAL TOTAL (ROUNDED)				**$77,000**

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Bunker Hill
Guy Cave Slope Stabilization
Alternative 3 - Slope Stabilization with Drag-line
Order of Magnitude Cost Opinion

DATE: 12/19/2000
PROJECT NO.: 152220.ET.02
ESTIMATE BY: D. Hedglin

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
Access				
Move Power Line	1	LS	700.06	$700
Clear & Grub	1	LS	1,487.41	$1,487
Grade New Road	180	LF	33.47	$6,024
Gravel Surfacing	60	CY	23.72	$1,423
Move Slope Material				
Excavate & Move to Bottom w/Dragline	5,000	CY	7.31	$36,545
Grade & Compact Toe	1,000	CY	7.44	$7,437
Grade Slope	2,000	CY	3.72	$7,437
SUBTOTAL				**$61,054**
MISC ALLOWANCE	**5%**			**$3,053**
SUBTOTAL				**$64,107**
CONTINGENCY	**30%**			**$19,232**
SUBTOTAL				**$83,339**
MOBILIZATION	**20%**			**$16,668**
CONSTRUCTION TOTAL				**$100,007**
SALES TAX ON MATERIALS	**5.0%**			**$60**
ENGINEERING AND SUPPORT	**10%**			**$10,001**
CONSTRUCTION MANAGEMENT	**8%**			**$8,001**
CAPITAL TOTAL (ROUNDED)				**$118,000**

NOTES:

Misc Allowance markup is to include items known to exist but cannot be quantified at this time.
Contingency is for scope changes that are presently unforeseen.
Mobilization includes bonds, insurance, temporary facilities, health & safety, demobilization, etc.

NOTE: The above cost opinion is in December 2000 dollars and does not include escalation. The order of magnitude cost opinion shown has been prepared for guidance in project evaluation from the information available at the time of preparation. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final project schedule and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.